A VARIABLE SUN

The Principal Cause of the

Great Glacial Period.

By WILLIAM NIMS.

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"IN THE BEGINNING."

IN *the beginning* was inconceivably long ago. An *infinite past* is behind us and an *infinite future is* before us. . . . . .

At some time in that *infinite past*, what is now our sun, the mother of our planets, was a vast, diffused, rotating, spheroidal body, occupying with its equator all the space out to and much beyond the orbit of Neptune. Its equatorial diameter then was more than six thousand million miles. Its equatorial diameter was about five thousand six hundred million miles, when the plane of its equator only filled the orbit of Neptune.

From the time when it became a rotating, spheroidal body, it was all the while falling in on itself, all the while condensing, and all the while increasing its *rotation velocity*.

It was then composed of a vast number of *diffused atoms*, each one as the result of rotation being a *projectile*, projected tangentially, and each one, as the result of gravitation, being also a *falling body*, falling towards the centre, and in accordance with *the law of falling bodies*, continually increasing in velocity as it fell.

This increase of *falling velocity* was, of necessity, constantly added to *projectile velocity*. The projectile velocity of these atoms therefore continued increasing, in all parts of our embryonic Sun, until finally the atoms *located upon its equator*, had accumulated enough projectile velocity to establish *for them* a balance between *centrifugal* and *centripetal* forces. These balanced atoms still revolved, but fell no nearer the Sun's centre. *Balanced circular motion* had been established for them.

The same forces continued establishing balanced circular motion for the atoms located for the time being upon the equator of our perpetually condensing embryonic Sun, and therefore in the plane of its equator *a broad, thin, revolving ring of atoms* was left behind.

The atoms of each inside layer of this ring of necessity revolved with a *greater velocity* than the atoms of its next outside neighbor.

Neptune was made out of an aggregation of the atoms of this ring.

When our Sun just filled the orbit of Neptune it made an axial revolution in about one hundred and sixty-four of our years.

When it first acquired rotation velocity sufficient to establish on its equator a balance between centrifugal and centripetal forces, it then began parting with, leaving behind, in the plane of its equator, the material out of which all the planets and moons and meteors and comets have since been made. It began this *ring work* outside of the orbit of Neptune and ended it inside of the orbit of Mercury.

It parted with about the seven hundredth part of its substance while doing this ring work.

A rotating sun has at its equator centrifugal and centripetal forces in balance when its velocity of rotation on its equator equals the square root of the fraction, *one* over *the number* representing that sun's radius. If r be the radius, then the square root of *one* over r will be the velocity.

Each and all the planets are under the same law. It is simply the law of balanced circular motion.

When the Sun's radius equalled the radius of the Earth's orbit, its rotation time was about three hundred and sixty-five and a quarter days, or one year. When the radius was four times the radius of the Earth's orbit, its rotation period was eight years. A point on its equator had then four times as far to go to complete a revolution and it only went half as fast. The square root of *one* over *four* is *one-half*. When its radius was nine times the radius of the Earth's orbit, it rotated only one-third as fast, and had nine times as far to go. Its rotation period was therefore then twenty-seven years.

The velocities of the various planets in their orbits are in the inverse ratio of the square roots of their distances from the Sun. The same law holds with all the atoms of sun rings, and with all the nuclei formed of these atoms. Under this law each outside nucleus was in its turn, overtaken by its faster moving next inside neighbor and both, by their mutual attractions, were then drawn together and became one. In this manner rings were formed into planets. Saturn presents a miniature solar system, rings and all. The planetoids present a case of solar ring material broken up into a great number of small unaggregated nuclei. These nuclei would have united except for the overmastering attraction of Jupiter. Venus and Mercury present cases of unattained, balanced circular motion. [*One* over r^2 equal to v^2 over r] is the formula for balanced planetary circular motion. This formula reduced gives [v equal to the square root of *one* over r.]

The Earth was made out of an aggregation of its share of ring material, located both outside and inside its present orbit. Its rotation period was then the same as its present orbital period. It obtained its original rotation motion from the ring out of which it was aggregated. Each and every atom of this ring turned over once during each revolution of the ring.

Condensation increased the Earth's rotation velocity until it acquired, on its equator, balanced circular motion. It then began parting, in ring form, with a portion of its substance, and out of this ring substance the Moon was made.

The earth had a diameter of nearly three million miles when it first acquired balanced circular motion.

When the Earth's diameter equalled the diameter of the Moon's orbit, its rotation period was about twenty-seven and one-third days, and if its rotation velocity had not been resisted, its rotation period, at its present diameter, would have been about eighty-two minutes. The Moon and Sun and planets have prevented it from accumulating as much rotary motion as it otherwise would have accumulated. The Moon has been, and still is, the principal resister.

When the Earth was larger than it is now, its material was in a more diffused and yielding condition, and this diffused matter then had its tides, as the waters of the oceans now have their tides.

Nearly all mountain ranges run northerly and southerly. Nearly all run mainly in the direction of coast lines. Their eastern sides are mainly gentle slopes, their western sides mainly precipitous. The force that pushed them

up pushed therefore mainly from east to west. A large amount of effective pushing was done while the Earth was in a diffused and yielding state, and before there was any water.

When water had been made, and the Earth's crust and also its metallic interior had become less yielding, then water became the principal tide worker.

After water was made and while the Earth's crust was still warm a great amount of evaporation occurred. Clouds were dense then.

The Earth is still slowly losing rotation velocity, and unless the waters of the oceans become solids, it will continue to loose it, until the length of its day becomes again twenty-seven and a third days.

The Moon has no more rotary motion than the ring had out of which it was made. It turns over once while it is going around the Earth once. All the other Moons behave in the same manner. The great tidal power of their respective mother planets prevented any increase of their rotary motion.

The resisting influence of the Earth on the outside, and of the Sun on the inside, prevented Venus from acquiring enough rotation velocity to enable her to leave behind any ring material, and she therefore has no moon. It is believed that Mercury always keeps the same face towards the sun. The planetary region, occupied by the numerous planetoids, would have had, instead of the planetoids, only one planet, if Jupiter, king of planets, had not prevented aggregation.

Tides affect the Earth as a brake affects a revolving wheel. If, in still air, a rifle ball be shot perpendicularly upwards, it will fall to the Earth to the west of the point from which it started. While it is above the Earth, it travels from west to east in a larger circle, but only with the velocity of th point from which it was shot.

On the side of the Earth next to the Moon, the waters of the oceans are raised above their normal levels by the Moon's attraction, and in falling back to their normal levels they fall to the westward. On the side of the Earth opposite the Moon, the waters of the oceans also revolve on a radius longer than their normal radius, because as related to the Moon, the Earth revolves around the centre of gravity between the two oodies. These waters also, therefore in falling back, fall to the westward.

Provide a light straight stick sixty inches long. Split this stick at one end and spread the split enough to receive the two ends of the axis of a ball weighing eighty ounces. Fasten firmly at the other end of the stick another ball weighing one ounce. At the balancing point between the two balls, on the outsides of the split, fix little journals. Place these journals on bearings. Now revolve the large ball on its axis. At the same time revolve the combination on its journals. It will be seen that the outside of the large ball revolves at the same time in two circles, one larger than the other.

The real cause of tides then is, that the waters of the oceans are slowed up by the outside disturbing attractions of the Moon, Sun and planets, while the solid Earth is not. A collision between land and water is therefore inevitable.

Gulf streams are only reflected tides, and are composed of warm water because the main part of tidal work is done between the tropics. Ocean water, from top to bottom is slowed up by the outside attraction of the Sun, Moon and planets, but if there were no ridges at the ocean's bottom and no coasts at its top, tides would scarcely be perciptible, and there would be no gulf streams.

The direction of flow of gulf streams is determined by the *trend* of the coasts from which warm water tides are reflected, and many of these coasts are below the ocean's surface. The equator of heat being north of the equator of latitude, tends to produce stronger gulf stream currents flowing northward. If there were neither hills nor valleys the waters of the oceans would now be about two thousand feet deep over the whole surface of the Earth.

If our Earth rotated about seventeen times as fast as it now does, centrifugal and centripetal forces would be in balance on its equator, and the matter on its equator as related to the Earth, would have no weight, could no longer fall nearer the Earth's centre. And if the Earth were still perceptibly decreasing its diameter, this weightless matter would soon become a concourse of little Moons, each revolving around the Earth in about eighty-two minutes.

If from the top of our highest mountain, a cannon ball could be shot tangentially, with a velocity of about five miles a second, and the atmosphere could offer no resistance, this ball would go, with a nearly uniform velocity entirely around the earth, and would so continue to do forever, thus becoming a little Moon, coursing only a few miles above us, and circling the Earth in about eighty-two minutes.

The crust of the Earth consists of metals and gasses chemically united. The thickness of this crust is unknown. But probably, as related to the Earth's radius, it is very thin. The solid Earth is, all of it, either metallic or a chemical union of the gasses and the metals. That part of the solid Earth below its crust is almost entirely metallic. Metals in interplanetary spaces were oxydized very sparingly.

The gravity of the Earth's water being taken as one, the gravity of the whole Earth is about six, of its crust about three and a half, and of iron only between seven and eight.

It is not probable that the Earth's metallic interior is either a perfect sphere or a regular spheroid. It probably has its hills and valleys, and there may be, localities where it is nearly pushed up through the crust. If the Earth's interior were liquid, tidal force would constantly shatter its crust.

Heat always results when gasses and metals form chemical unions. Gasses and metals must be brought together if chemical union occur between them. If a great number of gasseous molecules, and a great number of metallic molecules be brought together, in a small compass, rapid chemical union will occur, and great heat will be generated. Friction, resistance, collisions, blows product heat. When the molecules of gasses and the molecules of metals have completed their chemical union, the resulting substance fills much less space than the two substances filled before the union. During the process of combination and condensation, a vast number of intense molecular collisions occur, a vast number of hard molecular blows are dealt.

Heat was also generated by increase of rotation velocity, also by innumerable collisions of the materials of planet stuff, while rings were being worked up into planets, and innumerable collisions resulted from interior condensation and consequent crust folding and breaking. Heat was also generated by tidal work, in slowing up the Earth's rotation velocity.

When the Earth had twice its present diameter its attraction energy at its surface was only one fourth what it now is. The density of its atmosphere at its surface was therefore then only one-

fourth what it now is. Our coal fires burn more slowly when our barometer is low. Too light an atmosphere, too little oxygen to the cubit foot of air causes this.

There is probably a smaller percentage of oxygen in atmosphere now than there once was. Eight-ninths of water is oxygen, about one half of the Earth's crust is oxygen, and it is still in localities making crust. Oxygen has been consumed in great quantity by the other planets, and they are still consuming it. The Sun has also consumed and is still consuming a vast amount of it.

The Earth's diameter, when it began to be self luminous, was probably not more than about twelve thousand miles.

The Sun's atmosphere embraces all the planets, and extends much beyond them. Each planet appropriates to itself as much sun atmosphere as its attraction energy enables it to. The density of our atmosphere being taken as *one*, the density of Jupiter's is about *two and a half*, and the Sun's about *twenty-eight*, while the Moon's is only about *one-sixth*. At present about twenty per cent. of our air is oxygen, and it is probable that about the same percentage holds throughout the solar system. If the percentage were larger our fires would burn with greater vigor. Iron burns readily in pure oxygen.

The Sun had a diameter of about six million miles when it began to be dimly self luminous. It began to be self luminous as soon as its supply of oxygen was sufficient to support a flame. One twenty-eighth of its present supply was at first more than sufficient. The Earth had less than one twenty-eighth what the Sun now has when it was burning with its greatest intensity.

When our metallic Earth, by the force of its attraction, had made the air at its surface dense enough, then it commenced in earnest the work of crust building. Then like its parent Sun during her early luminous history, it burned with as much intensity as its supply of oxygen enabled it to, and so continued to do wherever the king of gasses could reach metals to combine with. It was larger then than it is now. It has shrunk considerably since then, and this shrinkage has caused many folds and breaks in its crust. Through these breaks oxygen either as water or air, or both, again reached the metals and again started fires, and some of these fires are burning still. All our present volcanoes were made in this manner.

The diameter of the Earth's metallic interior decreased a large amount during the long period its work of crust making was going on. At various times this crust work had so far progressed that the fires had largely burned out, when another sinking and another breaking up of crust again exposed a large area of metals and again started extensive fires.

The Sun is now doing the same manner of work and has been doing it all the while since it became a self luminous body. In that time it has decreased its diameter more than five million miles. All oxydation meant crust making, and all decrease of diameter crust breaking. At times large areas of its surface were crusted over, to be again broken up and the metallic surface beneath again exposed to oxygen. Cold periods and warm periods succeeded each other as these changes occurred.

When the Earth's temperature had fallen sufficiently low, and oxygen and hydrogen had united and formed water, then vegetation and then animal life began to appear in the waters and upon the dry lands. The Earth itself furnished enough heat and light to sustain

its first vegetables and animals. The Moon once helped some, for the Moon was once self luminous. It was never very brilliant however. Its atmosphere was too thin its oxygen too deficient. The Earth's early vegetation was all cryptogamic. It seems to require sunlight to produce flowers.

It is not probable that the oceans covered the whole Earth, at any one time, in all its history. Condensation work and tidal work and chemical work went on for countless ages before water was made.

The first hills and valleys were produced by these forces. The Earth's crust fell in because its bottom fell out. The diffused metallic interior, by condensation, left the crust behind. The cover was too large for the ball, and folds and breaks were inevitable.

There was much less dry land anciently than now. The continents, as we have them now, were mainly made after water was made. Stratified rocks—sandstone, shale and limestone—accumulated in the shallow seas, and tidal forces had in water a new and better tool to work with. The Earth's interior kept on shrinking and tides kept on pushing. The crust kept on folding and breaking and mountain ranges and table lands kept on elevating. The deep sea bottoms kept on sinking, partly because they had an enormous weight of water to carry besides their own weight, and the continents except as disturbed by tides and winds were held up by water as in a vise, for the lateral pressure of water at the same depth is equal to its downward pressure.

We probably have Eastern and Western continents because we have at the same time two opposite tides, and Northern and Southern continents because the great tide workers traverse to and fro the great tropical belt. The two heaviest mountain heaps of the Earth, one in the Andes and the other in the Himalayas, one near the tropic of Capricorn and the other near the tropic of Cancer, are diametrically opposite.

The equator of heat is several degrees north of the equator of latitude. The continental equator is many degrees north of the equator of latitude. The equator of heat, being located north of the equator of latitude, has had much to do with making the dry land area of the Northern hemisphere greater than that of the Southern. An excess of both warm water and warm air have flowed northward for ages and ages. Air has also its tides and gulf streams.

Water was not made all at once. It took a long time to make it all. When temperature conditions were right for making it, it could not have been made faster than the Earth was able to pull in sufficient oxygen and hydrogen. Archean crust making was well advanced before water was made. Water probably battered down, by tidal work, many of the northerly and southerly ridges of the southern hemisphere. Between the tropics it battered the Northern and Southern continents in two, for there its tidal force was greatest. An excess of water in the Southern hemisphere has to do with its being colder than the Northern.

Our Earth was self luminous before our Sun was self luminous. Our Sun has been self luminous during only a short comparative period. It is only about a quarter as dense as the Earth is now. It condensed through a radius of nearly ninety million miles, after it left most of the material of the Earth behind, before it became self luminous. It is not probable that man was here until after the Sun became self luminous. He was probably present during the great

glacial era. Our Sun's sun is probably not yet self luminous.

Our great glacial period, with its ice a mile or more in thickness, occurred at the time when the fires of the Earth had *mostly* gone out and the fires of the Sun for the time being had *largely* gone out. The Sun as a heating luminary is not a constant force. It has been hotter and colder than now and will be again.

A warm era preceeded and another succeeded the great ice era. Ancient river beds were filled with glacial debris during the ice era. The intensity of the Sun's heat must have varied *considerably* during these three eras. Between two succeeding equinoxes, with the Sun a constant heating quantity, it would bestow exactly the same amount of heat upon the Earth, whether the major axis of its elliptical orbit were longer or shorter, or whatever the position of the equonoctial, as related to the ellipse.

The phenomena of revolution of our equonoxes, revolution of our elliptic orbit, lengthening and shortening of the major axis of our elliptic orbit, circulation of ocean currents, circulation of air, presence or absence of clouds, and alternate rising and sinking of the Earth's crust, all taken together, are insufficient to account for the recent presence of the frigid zones in the neighborhood of the torrid zone, or the more recent presence of the torrid zone in the neighborhood of the frigid zones. A recent platteau some miles in height, running easterly and westerly, and covering a large part of the northern half of the northern temperate zone probably did not at any time exist. Hills run mainly northerly and southerly. The force that pushed them up pushed mainly from east to west.

From the time when our Sun began to be a star it has been and is now, from necessity, a constantly varying star. Some new device for measuring its varying heat, from year to year, should be invented.

The Sun was quite a vigorous heater previous to the great ice era, and its heat waned during that era, and then waxed again during the Champlain era. The Sun began to burn when its attraction energy at its surface was considerable less than the present attraction energy of the Earth at its surface, and other conditions being equal, it would now burn with more than twenty-eight times its ancient vigor. Its percentage supply of oxygen is however now probably somewhat reduced, and what there is finds it somewhat more difficult to reach its metals. It has arrived at its present stage of development through numerous vicissitudes.

Immediately succeeding the great ice period occurred a *very* warm period, a period when there was perhaps no ice in summer, even at the poles. The Mastodon, a huge hairless elephant, whose bones have not yet all decayed, then lived and thrived in the climate of the northern temperate zone, and the Mammoth a huge hairy elephant, whose bones also have not yet all decayed, then enjoyed the climate of the Arctic zone. The same kind of vegetation flourished then in the Arctic zone that now flourishes in the temperate zones, and much of this vegetation is not yet decayed. It would have been easy then to have gone to the north pole, and perhaps some people from Asia went there.

The Sun was larger, at the Champlain period, than it is now, and perhaps hotter too, as related to its size. If it had twice the diameter and was no hotter, it would send to us four times as much heat.

The glacial period and the succeeding

warm period were the very last geological events of much magnitude that occurred to our Earth. The result of their work is left right on the surface. We travel over it every day.

The present corrugations of the Earth's surface, its hills and its valleys, were produced by tidal work, by sliding towards the poles work, by condensation work, resulting in folds and breaks in its crust, by volcanic work, by precipitation work, by moving glacier work, by river work, by frost work, by air work, and by vegetable and animal work, and all this work is still slowly going on, so slowly that no cataclysm of much magnitude is liable to soon again occur.

The northerly and southerly corrugations are largely a measure of the tidal work that has been done upon our Earth, and the thirteen mile equatorial elevation is what is left of its tendency to leave ring material behind. It has lost sixteen-seventeenths of that tendency. If it had lost none, equatorial elevations would be much higher than they are now. If the land elevations at the equator were no higher than they are now, and the Earth's rotation velocity were seventeen times what it is now, the polar regions would be dry land and the oceans would circle the globe at the equator. Either a liquid or a plastic body left to itself will take the form of a sphere. If the Earth were to lose all its rotation velocity the oceans would then be somewhat deeper at the poles and somewhat shallower at the equator.

It is estimated by Sir William Thompson to be now losing rotation velocity at the rate of twenty-two seconds a century. The rivers of the Northern hemisphere that run south decrease rotation velocity, because they run from smaller to larger circles of latitude and therefore constantly push against their western banks. Those that run north produce an opposite effect. The rivers of the Southern hemisphere that run north decrease and those that run south increase rotation speed. Meteors that reach the earth, whether as masses or dust, slow up its rotation speed.

When balanced circular motion is established at the surface, it is established in the whole equatorial plane, down to the Earth's centre. Not any of the matter in that plane, as related to the Earth, has any weight.

Rotation force, not only pushes all the matter located between the planes of the equator and the respective poles, towards the equator, but it neutralizes a portion of the gravity of all this matter. It all, as related to the Earth, weighs less than it would if no rotation existed. As the Earth's rotation velocity was slowed up, this same matter was not only pushed back by gravity toward the poles, but was also pushed toward the axis of the rotating body. There would result from this backward pushing, especially if the material of the Earth were in a somewhat yielding state, a tendency to form east and west corrugations, and probably what the Earth has of such corrugations resulted mainly from this cause.

The Earth is evidently not a regular spheroid. The northern temperate zone has its great east and west watershed on both continents, from which the rivers run both north and south. It was mainly upon this watershed belt that the great glaciers were formed. Where rivers will flow, glaciers will flow. It was down the southern slope of this watershed that the great glaciers moved.

The oceans now cover nearly the same areas they covered at the time of the great glacial period, and the elevations and depressions of the continents are